ENTERPRISE ARCHITECTURE FOR DOD ACQUISITION

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The Department of Defense (DoD) could achieve substantially higher acquisition cost savings by following the lead of industry in applying systems engineering theory to organizational structure, to develop an enterprise architecture for DoD acquisition.

The Department of Defense has made great strides within the past five years in moving defense acquisition processes toward successful business practices. Despite the undeniable successes achieved, acquisition reform has the potential to achieve substantially more costs savings than have to date been realized. These potential savings must be achieved if the services are to be able to modernize for tomorrow's operational demands.

Much of the equipment used by our warfighters is old, and gets older each day. The costs associated with supporting these systems are increasing with time. Although it appears that continued reductions in defense procurement budgets may level off and may actually increase in the coming years, more procurement dollars will be needed to meet the needs of the services. Jacques Gansler, Under Secretary of Defense for Acquisition, Technology, and Logistics (USD [AT&L]), has continually spoken of the need to generate the dollars necessary to modernize forces while continuing to meet the operations and maintenance demands of high operational tempos.

Where will these funds come from? The premise of this article is that DoD could achieve substantially higher acquisition cost savings by following the lead of industry in developing an enterprise architecture for DoD acquisition. Commercial corporations have discovered that efficient business processes must be carried out within streamlined, seamless organizational structures. To achieve higher cost savings, DoD must reengineer its organizational structure. This will require a change in focus from optimizing individual departments and functions toward a top-down approach that focuses on optimizing the DoD acquisition system at the highest (enterprise) level.

The proposed solution is the development of an enterprise architecture for DoD

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2000		**00-00-2000 to 00-00-2000**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Enterprise Architecture for DOD Acquisition	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Defense Systems Management College ,9820 Belvoir Road,Fort Belvoir,VA,22060-5565**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Acquisition Review Quarterly, Spring 2000

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**10**	

acquisition. Enterprise architecting is the application of proven systems engineering principles for integrating complex systems applied toward integrating complex organizations. Most large corporations have realized that they cannot be effective and survive the commercial marketplace unless they develop an architecture for their organization that provides a seamless integration between different elements of the corporation. The larger and more complex the organization, the more critical this is. When subsystems of either a physical or organizational system are not designed to be interoperable with seamless operation across the interface, an "architectural mismatch" occurs and poor system level performance results.

"Systems engineering was developed as a process to design systems from the top down."

ENTERPRISE ARCHITECTURE

What is an enterprise architecture? By the definition of John Zachman, "Architecture is that set of design artifacts, or descriptive representations, that are relevant for describing an object such that it can be produced to requirements (quality) as well as maintained over the period of its useful life (change)" (Zachman, 1991, p. 4). An enterprise architecture is developed by applying this concept to the organizational, or enterprise, level of a company or organization. This can be accomplished by applying many of the tools of systems engineering to the engineering of an organizational structure.

The discipline of systems engineering came about as industry began to develop complex systems and products. Engineers realized that having specialists first design and build optimized components and then attempt to integrate them resulted in poorly performing systems. This method was also time-consuming and expensive as many components required extensive redesign and rework to get them to be interoperable. Furthermore, the voice of the customer was often lost in the pursuit of optimum performance at the subsystem level.

Systems engineering was developed as a process to design systems from the top down. The system level architecture is defined first. Subsystems and components are then designed to support the system requirements and to be interoperable with other components and subsystems. In many cases, this requires that the individual subsystems or components be suboptimized. However, the result is a better overall system that can be developed faster and at a lower cost.

Many large, complex corporations have realized that this same principle applies to the architecture of an organization. Most corporations have traditionally been organized around functional areas such as marketing, accounting, engineering, and public relations. In most cases, these functional departments were designed to be the most efficient at the functional task they performed. This has led to efficient departments that combine to produce dysfunctional organizations.

The epitome of this type of structure is satirized in the cartoon strip "Dilbert." Dilbert attempts to do his job amidst insurmountable trials and tribulations: Research won't give him the product

requirements, accounting reduces his budget, his boss tells him to get started without the requirements so he looks busy to upper management, and on and on. Why is the "Dilbert" cartoon strip so popular? Probably because so many of us can relate to these issues in our daily jobs.

Major commercial companies are realizing that this type of functional behavior is inefficient and wasteful, and that it threatens their future survival in the global marketplace. They are developing enterprise architectures to integrate their organizations and provide a clear vision of where they are headed in the future.

A good analogy of the process involved in developing an enterprise architecture is a city planning commission. These commissions make zoning laws, review building plans and permits, manage building codes, and grant deviations on a case-by-case basis. They monitor demographics, economics, changes in technology, and attitudes in the community. For a city to operate effectively, the commission must balance the conflicting priorities and goals of diverse groups such as its citizens, builders, businesses, and employees. Interfaces between these conflicting groups must also be managed so that the best interests of the city as a system are achieved. The process must also be responsive to change.

Why does enterprise architecting play such a large role in commercial companies? In 1967, 40 to 50 percent of the cost of a product was direct (touch) labor. Today that percentage is as low as 15 percent. At the same time, between 20 and 50 percent of all labor cost in the United States is now dedicated to gathering, storage, retrieval, reconciliation, and reporting of information used to run the company (Zachman, 1997, pp. 8–10).

Because of the functional organization of most companies, this task is being accomplished with horrible inefficiencies. Larry English of Information International has observed that 70 percent of computer printouts were used to enter the same data into a different database. Bill Smith of William G. Smith Associates has observed that 70 percent of the lines of code used by a company are doing nothing but moving data from system to system and 40 percent of machine cycles are expended moving data that produces no useful work. At a cost of $1 to $4 per line of code for Y2K correction and testing, the price tag to ensure that these programs are now working is in the hundreds of billions of dollars. Statistically, the average data fact is stored 10.8 times within a company information structure (Zachman, 1997, pp. 8–10). Since DoD is heavily engaged in generating and using information (rather than producing physical products), our percentages are likely worse than our commercial counterparts.

"A good analogy of the process involved in developing an enterprise architecture is a city planning commission."

Figures such as these are bound to capture the attention of any chief executive officer. As Doug Erickson remarked, "Where do you think management is going to get any more major chunks of cost reduction? It looks to me like these enormous costs of architectural discontinuities and redundancies are now the 'low hanging fruit' just waiting to be

picked" (Zachman, 1997, p. 10). The best part of the enterprise architecture is that up-front investment is minimal compared to other cost-saving initiatives, such as automation. Like systems engineering, much of this is just a commonsense approach to doing business. The difficult part will be to smash down the walls of functional bureaucracy in implementing these changes.

Some may argue that DoD is already embarked on development of an enterprise architecture through implementation of the "joint technical architecture" and other standardization initiatives. It is certainly true that these initiatives will increase interoperability between functional groups and organizations through improved design practices. However, this effort falls far short of the organizational change required to achieve a seamless, integrated acquisition organization. In business process reengineering, the first rule is to optimize the process before considering how to automate it.

In enterprise engineering, the issue is not how to make a functional group more efficient, but how to make the organization the most efficient. Instead of initiatives to make the travel section more efficient, the more appropriate question is, do we even need a travel section? Perhaps the organization would be better served by placing travel service functions on the corporate Intranet and having employees make reservations and enter claims data directly into the system. Many current acquisition reform initiatives fall into the category of continuing optimization of functional areas, for example, in improved contracting processes and improved design practices. To achieve the full potential of the reform initiative, we need to focus more on optimization at the enterprise level.

Table 1. Zachman Framework[a]

	Data *What*	Function *How*	Network *Where*	People *Who*	Time *When*	Motivation *Why*
Scope: ***Planner***						
Enterprise model: ***Owner***						
System model: ***Designer***						
Technology model: ***Builder***						
Detailed representations: ***Subcontractor***						

[a] From Zachman (1997, p. 5).

ZACHMAN FRAMEWORK

How can DoD develop an enterprise architecture? The most applicable approach to enterprise architectures for DoD I have found is the Zachman framework (Table 1). John Zachman worked in information systems for airframe manufacturing in the early 1970s. He developed his enterprise architecture when he realized that the same principles of systems engineering used to engineer complex physical systems could be applied to engineering large, complex organizations. These important elements included a clear understanding of requirements (goals of the organization), seamless internal and external interfaces, prudent managed risk taking and managed change. He developed enterprise engineering to accomplish these goals.

Like systems engineering, enterprise engineering takes a top-down approach toward development of the enterprise structure. DoD acquisition would fit the Zachman framework outlined in Table 1 as follows: The Office of the Secretary of Defense (OSD) would be the planner (row 1). The owner is the user of the system (row 2). The designer is the acquisition program office; the builder is the prime contractor of the system; and the subcontractors (row 5) would be subcontractors to the prime. The columns of the Zachman framework then ask the questions: what, how, where, who, when, and why. Filling in the process model in each block and then coordinating the interfaces between each would provide the DoD acquisition architecture, ensuring that all necessary functions are addressed, that the functions performed at each level are defined and understood, and defining the relationships between levels.

The Zachman framework provides an excellent template for developing the architecture of just about anything. However, Zachman left out one important aspect of systems engineering in his framework that would be essential to implementing an enterprise architecture in DoD. Metrics is an important element of tracking progress toward achieving a goal in any endeavor. I would therefore recommend that one additional column be added to the framework labeled "progress." This would be the metric that provides the key measure of success toward achieving the "what" of column one.

"Like systems engineering, enterprise engineering takes a top-down approach toward development of the enterprise structure."

APPLYING THE ZACHMAN FRAMEWORK TO DOD

The Zachman framework can make important contributions to acquisition reform. Policy makers have focused on the what, how, where, and when of what has to be done. They have done little to identify the who or the why. A key part of the systems engineering process is the assignment of responsibility and metrics to track progress toward achievement of the goals. Another key is providing the motivation of column 6 to accomplish the goal.

In a recent speech at the Defense Systems Management College, Vicky Farrow, chief learning officer of Lucent Technologies, Inc., described how demanding good personal performance on the job was a major part of Lucent's rise from single-digit growth as a part of AT&T to growth rates in the 20th percentile as an independent company (1999). She described how one employee was interviewed and asked what her job was. The woman explained that her job was to go to job fairs and to talk to students about working at Lucent. When asked how many students to which she had spoken put in applications, she said she had no idea.

Commercial industry has realized that each person must understand the goals of the company and the part their particular job plays in the achievement of those goals. To make sure that these individual linkages are defined, top companies provide personal incentives to their workers. These can take the form of bonuses for exceptional achievement or removal for consistent substandard performance. How many DoD employees do we have that are like this woman? They go to work every day and perform their work with little or no understanding of the relationship between their jobs and the higher level goals of supporting the warfighter or achieving the goals of acquisition reform.

"Establishing motivation is more difficult in DoD because of many rules for paying and firing government employees."

Establishing motivation is more difficult in DoD because of many rules for paying and firing government employees. But there are certainly some personal motivations that could be put in place under existing law. For example, to reduce development time, OSD might assign responsibility to a senior executive service (SES) employee to reduce the time to get through a milestone decision by 50 percent over three years. Times would be measured and tracked and the SES's bonus would be directly tied to the achievement of the intermediate goals for each year.

Developing an Enterprise Architecture

An overview of the enterprise architecture planning process is presented in Figure 1. Following the top-down approach of systems engineering, this process layers out four phases of planning for the implementation of an enterprise architecture. The four steps of planning corresponding to the four levels above ask (Spewak, 1993, p. 14):

- Where do we start?
- Where are we today?
- Where do we want to be in the future?
- How do we get there?

By answering these questions and filling in the Zachman framework, the outline of the enterprise architecture is formed.

Another area in which the Zachman framework could be applied to DoD acquisition is the identification of the interfaces between the various rows of the

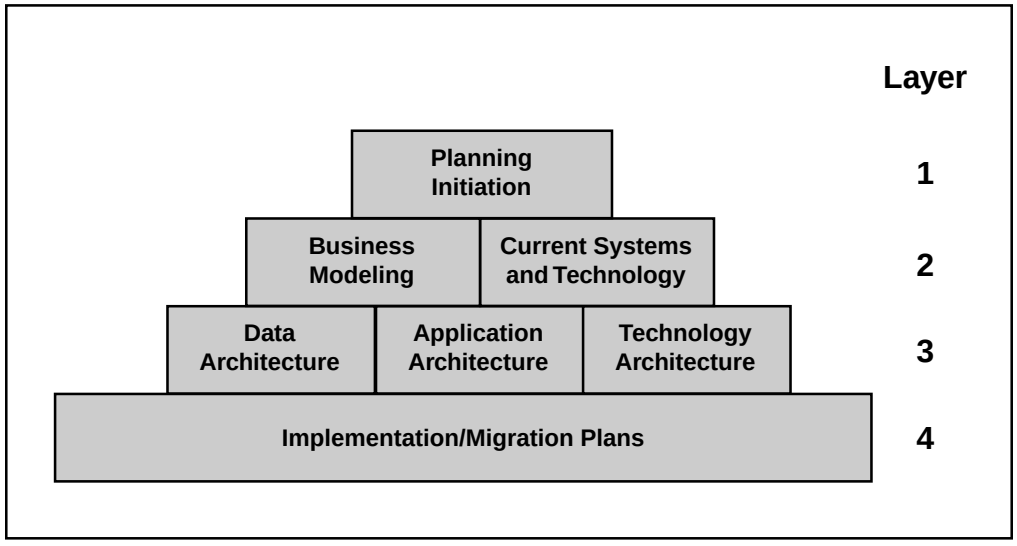

Figure 1. Components of Enterprise Architecture Planning

framework. Some progress has been made in improving the interface between the user and acquisition communities. The Joint Strike Fighter program was able to integrate the user into the program management structure through the integrated product team (IPT) process.

By assigning a group of users to the program office staff to work with the many stakeholders in the Air Force, Navy, and Marine Corps, the users worked side by side with the acquisition community in scheduling, risk analysis and assessment, budgeting, and all other facets of program management. They received training in program management like their acquisition corps counterparts. They used structured methods such as quality function deployment (QFD) to trade requirements not just for performance, but across a broad range of acquisition issues such as cost, producibility, logistics supportability, and development schedule. Requirements were rigorously scrubbed by running them through a variety of modeling and simulation tools to validate whether a requirement actually produced a measurable benefit. They motivated the services to send the best and brightest by providing joint duty credit (a requirement for flag officers) for those that served in the billets.

Unfortunately, this initiative cannot be repeated across all programs. There are not enough users to assign them full time to every program office. However, using the Zachman framework, some of the underlying principles of the successes achieved in this pilot program should be transferable. These include training of requirements writers in basic acquisition policy, operational requirements document development through an IPT process including all stakeholders, use of structured methods, requirements validation through simulation-based acquisition tools, and a system that recruits the best and rewards those that perform well.

Implementing an Enterprise Architecture in DoD

Successful implementation of enterprise architectures is difficult to accomplish in any setting. Many efforts in the commercial sector have failed for reasons common to any endeavor to institute change. These include a lack of management acceptance, failure to motivate personnel to cooperate, focus on short-term gains, political differences over responsibility, and lack of resources. Implementing a seamless acquisition process within DoD will be extremely difficult in that it directly conflicts with the first law of bureaucracy, which states: "The first priority of a bureaucracy is the preservation of the bureaucracy."

"Successful implementation of enterprise architectures is difficult to accomplish in any setting."

Much of the increased efficiency achieved in the commercial sector has been done by targeting middle management in restructuring and downsizing. The recent Government Accounting Office (GAO, 1996) report on downsizing shows that government organizations have protected managers while downsizing workers. Industry has generally found that the use of outside consultants was necessary to achieve a more efficient organization when downsizing. This suggests that development of a DoD enterprise architecture should be done with the assistance of outside consultants.

Overcoming resistance to change should not be underestimated. The commercial sector has also found it difficult to implement major changes to the way they do business. Implementing major changes sometimes requires development of a totally new organization. General Motors created the Saturn division because they could not institute the required changes to automobile manufacturing within their union plant structure. Lucent Technologies achieved their threefold increase in growth after being created as a spinoff company of AT&T Corporation. DoD has also experimented with small, independent organizations to implement totally reengineered business processes in place of large, existing bureaucracies.

The Joint Advanced Strike Technology Program (currently the Joint Strike Fighter) was created to operate outside the Air System Commands of both the Navy and the Air Force. To date, it has successfully operated with a much smaller, leaner office structure than comparable aircraft development programs. Creation of small, spinoff operations operating outside the normal functional bureaucracies appears to be a successful method of instituting reengineered organizations at a much more rapid pace than incremental change within large, established organizations.

Conclusions

Commercial industries are realizing that the best opportunities for reducing costs are in the architectural mismatches that exist within their corporations.

Realizing these cost savings will be essential to survival in a global economy. DoD must find new ways to achieve the cost savings necessary to replace the numerous aging systems throughout all service branches. Development of an enterprise architecture including seamless interfaces between each level, assignment of responsibilities, metrics for measuring success, and personal accountability for results could be a substantial contributor to achieving the needed efficiencies and cost savings. The Zachman framework, with the addition of a metrics column, provides the best template for defining an enterprise architecture for DoD.

Implementing the enterprise architecture will be the most difficult challenge, as it will require imposing change on entrenched bureaucracies. Transferring responsibilities to reengineered, smaller organizations is one proven method of achieving rapid change on a large scale. The question is not if DoD will follow the lead of industry, but when. John Zachman (1997, p. 11) expressed it best when he said, "My opinion is, we are on the verge of seeing architecture 'come into its own,' and in the 21st century, it will be the determining factor, the factor that separates the winners from the losers, the successful and the failures, the acquiring from the acquired, the survivors from the others."

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